DEFENSE INFORMATION SYSTEMS AGENCY

JOINT INTEROPERABILITY TEST COMMAND
FORT HUACHUCA, ARIZONA

DEFENSE SWITCHED NETWORK GENERIC SWITCH TEST PLAN (GSTP)

APRIL 2004

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GENERIC SWITCH
TEST PLAN
(GSTP)

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EXECUTIVE SUMMARY

The Defense Switched Network (DSN) provides non-secure end-to-end command and control (C2) capability via dedicated telephone service, facsimile, voice-band data, and dial-up Video Teleconferencing (VTC). For system functionality, the DSN is defined as including the end instruments, installation switches, backbone and tandem switches, transmission connectivity between and among the switches, the network management system and the signaling system.

The policy for Department of Defense voice networks is defined in the Chairman Joint Chiefs of Staff Instruction (CJCSI) 6215.01B, which outlines the DSN capabilities, network interfaces, and services required to ensure end-to-end voice quality and interoperability. Based largely in part on the CJCSI, the Defense Information Systems Agency Generic Switching Center Requirements (GSCR) document identifies the minimum interoperability certification requirements and features for telecommunications switching systems. The Joint Interoperability Test Command (JITC) conducts its interoperability certifications of these systems using the Generic Switch Test Plan (GSTP).

The GSTP specifies test criteria and procedures for DSN telecommunications switches connected to or planned for connection to the DSN. Switch testing will determine, through procedures or letters of compliance, the degree to which switches are able to meet requirements for:

a. Interface/signaling requirements for trunks and lines.

b. DSN services (voice, facsimile, data, and VTC) requirements per interface and signaling type.

c. Switch features and capabilities.

d. Interoperability with DSN network gateway interfaces.

The GSTP test methodology consists of lab testing at the JITC Fort Huachuca facility of the system under test in an emulated DSN network. Test scenarios involving interface analysis, voice calls, facsimile, data, and video teleconferencing will be conducted. Switching system interface requirements will be verified using JITC test measuring and diagnostic equipment and/or through demonstration of the feature.

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SYSTEM FUNCTIONAL DESCRIPTION

The Defense Switched Network (DSN) provides non-secure end-to-end command and control (C2) capability via dedicated telephone service, voice-band data, and dial-up video teleconferencing (VTC). The DSN is also the primary means for secure (i.e., point-to-point dial-up to include the Secure Terminal Unit (STU), Secure Terminal Equipment (STE) and Secure Wire Terminal (SWT) family of secure voice terminal devices) communications for non-tactical C2 users.

For system functionality, the DSN is defined as including the end instruments, installation switches, backbone and tandem switches, transmission connectivity between and among the switches, the network management system and the signaling system. Processing or transport technologies (to include Voice over Internet Protocol (VoIP) and Voice over Asynchronous Transfer Mode (VoATM) systems) are also considered to be elements of the DSN.

The architecture of the DSN is a two level network hierarchy consisting of backbone switches managed by the Defense Information Systems Agency (DISA) and Military/Agency installation switches. Within the DSN architecture, the following categories or types of telecommunication switching systems can be found:

a. Tandem Switch (TS). TSs are core backbone switches that connect end office switches together and does not directly connect to end subscribers. The role of the TS is to provide efficient routing of telephone calls between End Offices.

b. End Office Switch (EOS). An EOS is an installation switch located at the camp/post/station (c/p/s) that provides voice services to a subscriber base. The role of the EOS is to provide DSN services and features to the subscriber via access lines and to connect to backbone switches using access trunks.

c. Multifunction Switch (MFS). MFSs are switches that combine the functions of both a TS and EOS within the same platform.

d. Small End Office Switch (SMEO). SMEOs are switches that may be employed when C2 functionality is required but not the full capability of an EOS. A SMEO provides End Office functions to a smaller Department of Defense (DOD) community requiring C2 services. SMEO technology is based on a commercial Private Automatic Branch Exchange (PABX) with Multi-Level Precedence and Preemption (MLPP) capabilities. The SMEO does not provide full DSN Network Traffic Management control capability, offers limited performance reporting, and may not support Signaling System 7 (SS7) signaling.

e. Private Branch Exchange Type 1 (PBX1). A PBX1 is a switch that provides DSN service to a small subscriber base and is MLPP capable. Based on requirements, a PBX1 may serve those non-C2 users defined as DOD users having a military mission that might receive C2 calls for orders or direction at precedence levels above ROUTINE, even though they do not have a C2 mission for issuing guidance or orders.

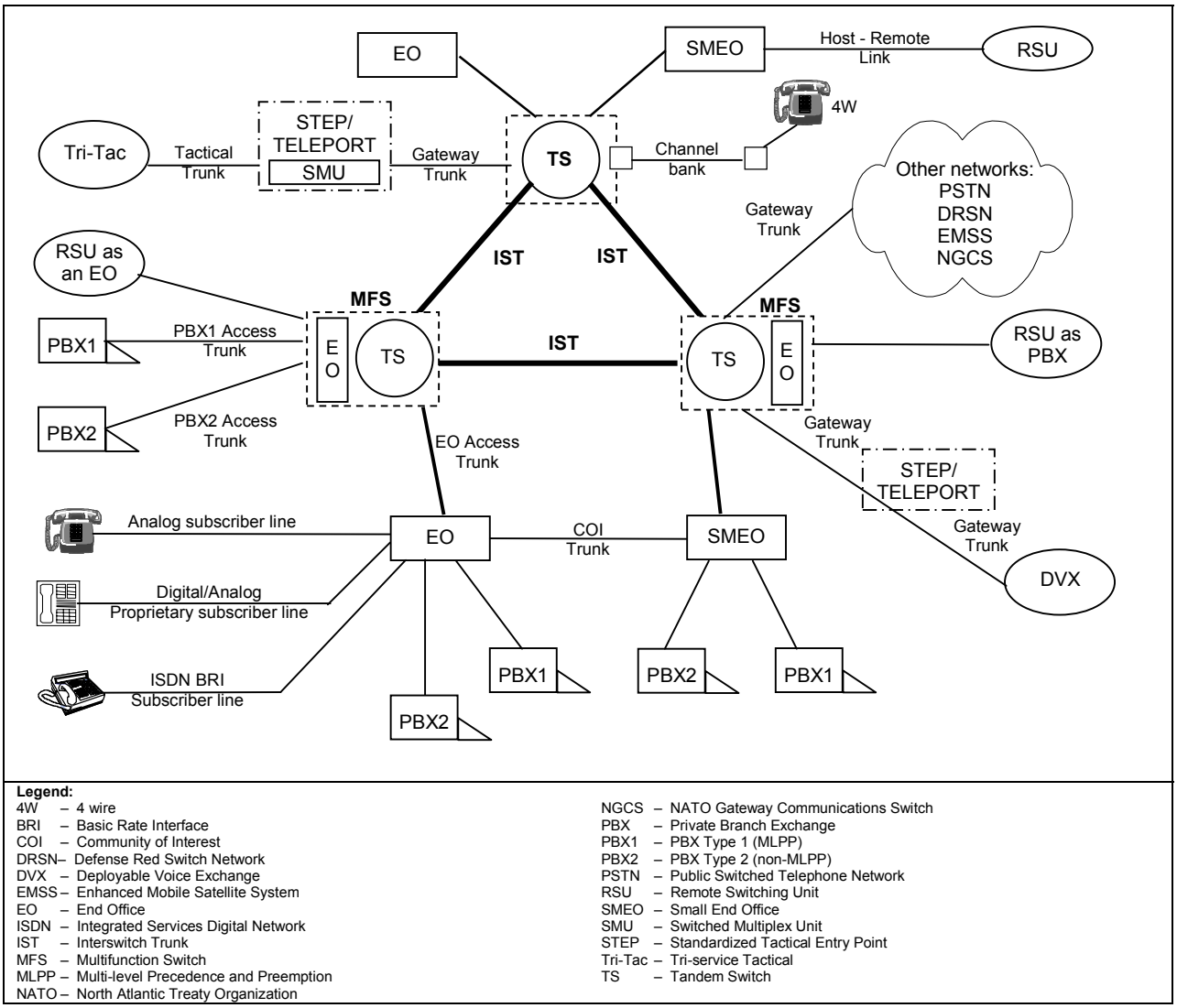
f. Private Branch Exchange Type 2 (PBX2). A PBX2 has no MLPP capabilities and can only provide service to DOD, non-DOD, non-governmental, and foreign government users having no missions or communication requirements to ever originate or receive C2 communications. These users are provided access to the DSN for the economic or policy benefits of the DOD, when it is not in conflict with local or Federal Communications Commission (FCC) ordinances. During a crisis or contingency, they may be denied access to the DSN.

g. Remote Switching Unit (RSU). An RSU is a switching device that depends in part on a host switch for call control but is capable of providing intra-unit switching. The RSU may be used to provide different functions: EOS/SMEO or PBX. If used as an EOS/SMEO, the RSU must meet all the requirements of an EOS/SMEO, and be connected via the host-remote link to a DSN Backbone TS or MFS. If used as a PBX the RSU must meet all the requirements of a PBX, and be connected via a host remote-link to an installation EOS/SMEO. RSUs will be tested in conjunction with their host switch for interoperability certification.

The DSN is comprised of several thousand switching systems of the various types mentioned above. Each switching system is a complex device that for military applications may have been modified from the commercial version to include military unique features (MUFs). To be authorized connectivity to the DSN, these switching systems must be interoperability certified to meet DOD requirements contained in Chairman Joint Chiefs of Staff Instruction (CJCSI) 6215.01B, “Policy for Department of Defense Voice Services,” DOD Voice Networks Generic Switching Center Requirements (GSCR) and Joint Technical Architecture (JTA) documents. These documents outline the switching system’s technical interface requirements, feature capability requirements, type of services to be provided, and what other networks the switching system may be required to connect to.

The following paragraphs outline the DSN architecture, types of DSN interfaces and DSN services provided over the interface, switching system capabilities, and other networks switching systems may connect to.

Figure 1 below depicts the switching system types specified in the DSN architecture contained within the GSCR. For certification purposes, switching systems are certified according to their ability to meet the requirements outlined by switch type as defined by the architecture.



Legend:

4W – 4 wire
BRI – Basic Rate Interface
COI – Community of Interest
DRSN – Defense Red Switch Network
DVX – Deployable Voice Exchange
EMSS – Enhanced Mobile Satellite System
EO – End Office
ISDN – Integrated Services Digital Network
IST – Interswitch Trunk
MFS – Multifunction Switch
MLPP – Multi-level Precedence and Preemption
NATO – North Atlantic Treaty Organization
NGCS – NATO Gateway Communications Switch
PBX – Private Branch Exchange
PBX1 – PBX Type 1 (MLPP)
PBX2 – PBX Type 2 (non-MLPP)
PSTN – Public Switched Telephone Network
RSU – Remote Switching Unit
SMEO – Small End Office
SMU – Switched Multiplex Unit
STEP – Standardized Tactical Entry Point
Tri-Tac – Tri-service Tactical
TS – Tandem Switch

Figure 1. DSN Architecture

Each of the different switch types is required to provide specific lines and trunks to ensure that the switch types can interconnect properly and that uniform services are provided to the end user. The types of lines required by DSN switching systems as specified in the GSCR are:

a. 2 wire with analog MLPP signaling.

b. ISDN Basic Rate Interface (BRI) with T1.619a MLPP signaling.

Though not required, vendors may provide other line types such as:

a. Proprietary digital.

b. VoIP.

The types of trunks required by DSN switches vary by switch type. The different types of trunks used within the DSN are:

a. T1 Signaling System 7 (SS7) with MLPP signaling (T1.619a). The TSs, MFSs and EOSs use the North American T1 1.544 Megabits per second (Mbps) SS7 to provide a modern efficient means of signaling. The SS7 network implemented in the DSN is similar to commercial networks with the exception that the SS7 protocol has been modified through the American National Standards Institute (ANSI) T1.619a specification to support MLPP.

b. E1 SS7 with MLPP signaling (Q.735.3). To support European theatre implementations, TSs, MFSs and EOSs are required to support the European E1 2.048 Mbps format. To support MLPP, the E1 commercial SS7 has been modified through the International Telecommunication Union (ITU) Q.735.3 specification.

c. T1 Channel Associated Signaling (CAS) with Multi-Frequency Recommendation1 (MFR1), Dual Tone Multi-Frequency (DTMF), and Dial Pulse (DP) MLPP signaling. CAS is used primarily at the c/p/s level to interconnect PBXs with EOSs or SMEOs. CAS services only support 56 kilobit per second (kbps) voice and data because of signaling limitations.

d. E1 CAS with Multi-Frequency Recommendation 1 (MFR1), Dual Tone Multi-Frequency (DTMF), and Dial Pulse (DP) MLPP signaling. E1 CAS services are used in the European theatre. Switches that are planned for use in Europe may be required to provide E1 CAS.

e. T1 Integrated Services Digital Network (ISDN) Primary Rate Interface (PRI) with T1.619a MLPP signaling. To support 64 kbps voice and data, T1 CAS is being replaced with T1 ISDN PRI. T1 ISDN PRI is the minimum connection between SMEOs and TSs. Similar to SS7, the T1 ISDN PRI used within the DSN has been modified with the ANSI T1.619a specification to support MLPP.

f. E1 ISDN PRI with Q.955.3 MLPP signaling. E1 ISDN PRI is used in the European theatre. The E1 ISDN PRI used in the DSN has been modified by the ITU Q.955.3 specification to support MLPP.

Interfaces must be capable of providing the following types of services:

a. Voice. The DSN provides both secure and non-secure voice services. Secure voice services are provided via the use of National Security Agency (NSA) approved secure telephones.

b. Facsimile (Fax). The DSN provides Group 3 Fax services, secure and non-secure.

c. Data. The DSN provides dial-up modem services to end subscribers, dial-up switched 56 kbps digital services and, where possible, 64 kbps Integrated Services Digital Network (ISDN) services. These services provide an improved capability for the DSN to support Secure Terminal Equipment (STE), dial-up video services, bulk data transfer, and other switched data transmission requirements.

d. VTC. The DSN provides switched services connectivity for the DOD common-user video teleconferencing system primarily through the use of 'bonded' ISDN services. The DSN also provides switched data circuit connectivity in support of user VTC long-haul transmission requirements.

DSN switching systems are required to provide specific feature capabilities as detailed in the GSCR. GSCR DSN switching system feature capabilities are:

a. Common features, such as number recognition.

b. Attendant console features.

c. Public Safety features, such as 911.

d. Preset Conferencing features.

e. Nailed-up Connection features.

f. Precedence Access Threshold (PAT) features.

g. DSN Hotline Service features.

h. Tandem switching features.

i. Network Management (NM) features.

j. ISDN Service features.

k. Synchronization features.

l. Reliability features.

m. Security features.

DSN switching systems may provide the capability to interconnect to RSUs and VoIP systems. RSUs may function in a normal or degraded operating condition as defined in the GSCR. Test procedures to verify both operating conditions are contained in this test plan. VoIP is an emerging technology being adopted in the DSN. Requirements for VoIP Systems (i.e., EOs and PBXs) and associated Local Area Networks (LANs) are contained in Appendix 3 to the GSCR. This test plan addresses both system and LAN test procedures.

DSN telecommunication switches may be required to provide DSN connectivity to other systems via CJCS approved network gateways; gateway examples include:

a. Public Switched Telephone Network (PSTN).

b. Tactical Networks.

c. Defense Red Switch Network (DRSN).

d. Enhanced Mobile Satellite System (EMSS).

e. North Atlantic Treaty Organization Gateway Communications System (NGCS).

TEST BACKGROUND

Vendors continuously provide new hardware and software in their switching systems to meet the demands for new features or to provide corrections to known problems. As new hardware or software is released, certification testing is required because switching systems (and associated hardware/software) connected or planned for connection to the DSN must have a Joint Interoperability Certification (JIC) prior to being authorized connection. Program Managers or DOD agencies must obtain JICs for new systems for which DSN connectivity is planned or for existing DSN telecommunication switches that have planned upgrades. Figure 2 shows the authorization process required for DSN connectivity. To receive a JIC, a sponsored switching system will be tested as to its ability to meet the requirements appropriate per switch type.

TEST PURPOSE

To determine the extent switching systems meet DSN interoperability certification requirements.

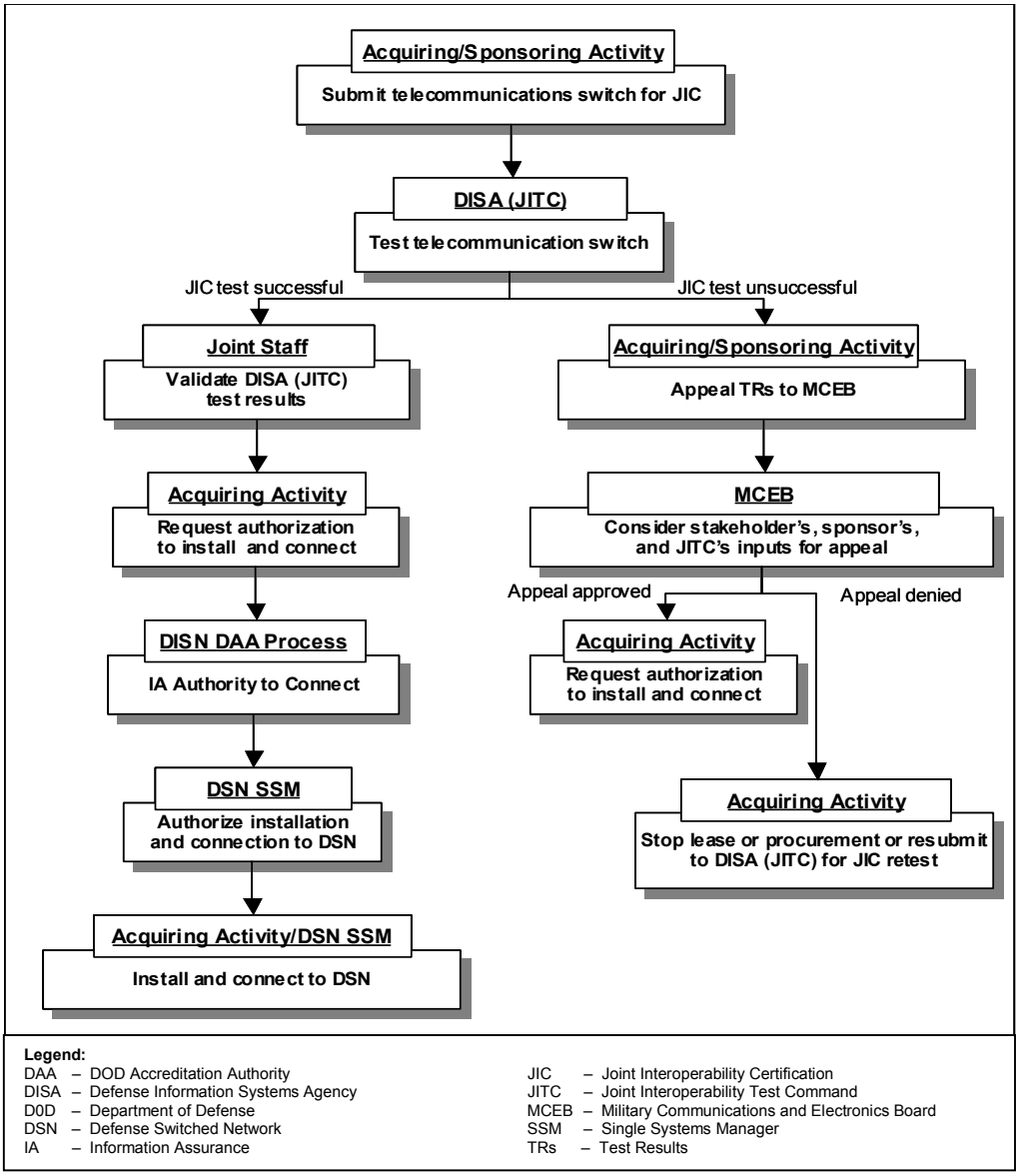


Figure 2. DSN Connectivity Authorization Process

REQUIREMENTS

The CJCSI 6215.01B outlines the DSN capabilities, network interfaces and services required to assure that DOD mission objectives can be met. It is the responsibility of CJCS to develop the process, procedures, and implementing instructions for JICs of DSN telecommunications switches. CJCS also serves as the JIC validation authority for DSN telecommunications switches. CJCS further delegates responsibility to DISA for DSN engineering, network design, and technical support. Figure 3 shows the relationship between DOD policies and the development of DSN telecommunication switch requirements.

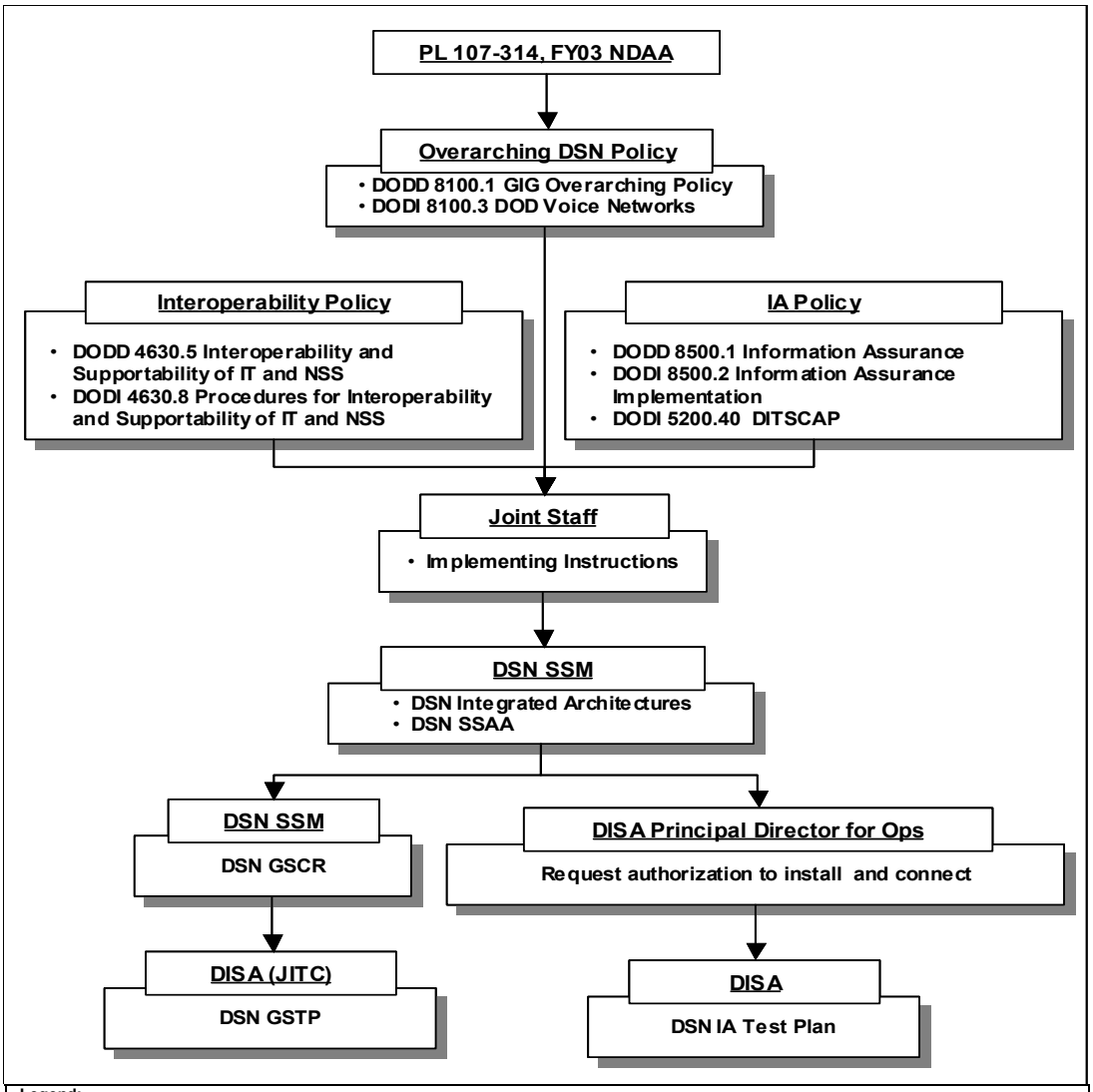


Figure 3. Policy and Requirements Relationship

It is DISA's responsibility to develop the GSCR which specifies the technical requirements for a telecommunications switch and is used to support lease or procurement, and testing of DSN telecommunications switches. The GSCR identifies the minimum switch requirements and features applicable to the overall DOD community for the respective networks. The GSCR also defines and documents the interoperability requirements among telecommunications switches that are part of the DSN. This DSN Generic Switch Test Plan (GSTP) is based on the requirements of the CJCSI and GSCR.

The GSTP specifies interoperability test criteria for DSN telecommunications switches connected or planned for connection to the DSN. The GSTP addresses interoperability requirements between new technologies; new technologies and the existing network; and the performance impact these new technologies have on MUFs.

To be interoperability certified, DSN telecommunication switches must meet the requirements of both the CJCSI and GSCR. Table 1 shows the CJCSI and GSCR associated requirements. The interoperability certification status of DSN telecommunication switches is based upon evaluation of:

a. GSCR interface/signaling requirements, applicable per switch type, for trunks and lines verified through interoperability certification testing and/or letter(s) of compliance (LoC).

b. The DSN services (voice, facsimile, data, and VTC) requirements as specified in CJCSI 6215.01B and DOD's Joint Technical Architecture (JTA) Version 6.0 as verified through interoperability certification testing and/or LoC.

c. GSCR features and capabilities requirements, applicable per switch type, verified through interoperability certification testing and/or LoC.

d. The DSN network gateway interfaces, applicable per switch type, as specified in CJCSI 6215.01B verified through interoperability certification testing and/or LoC.

e. The overall system interoperability performance derived from test procedures listed in appendix D.

Detailed requirements per switch type are provided in appendix C. Requirements are annotated as being either required (R) or conditional (C). Critical requirements are those requirements considered necessary for a particular switch type to support warfighter missions in DOD. These 'R' requirements detail the minimum set of requirements that must be met prior to being certified for use in the DSN. Conditional requirements are not considered critical for DOD mission support based on DOD policies. It is recognized, however, that some users may use 'C' requirements for specific operations. To ensure interoperability of MUF functionalities across the DSN, conditional capabilities provided for certification testing must meet the appropriate GSCR requirements in order to be certified for use in the DSN.

In conjunction with the detailed requirements per switch type, appendix C also details whether the requirements, 'R' and 'C' are to be verified through JITC testing or via LoC submitted by the vendor/Program Manager. Items to be verified by testing are annotated 'T'; LoC are annotated 'L', and those items that require both 'L/T'. 'T' and 'L' requirements are designated so at the discretion of JITC on behalf of the Joint Staff and DSN Single Systems Manager (SSM). Throughout the interoperability certification test, JITC reserves the right to test any letter of compliance requirement or waive testing of 'T' requirements.

Table 1. DSN Switching System Requirements by Switch Type

GSTP Ref.	Requirement		Switch Type					
			TS	MFS	EOS	SMEO	PBX1	PBX2
D-2	**DSN Interfaces**							
D-2.1	**Line**	**2 Wire Analog** (Access, Voice, Fax, Data & VTC)	NA	R	R	R	R	C[1]
D-2.2		**ISDN BRI NI 1/2 (T1.619a)** (Access, Voice, Fax, Data & VTC)	NA	R	R	R	R	C[1]
D-2.3	**Trunk**	**T1 SS7 (T1.619a)** (Trunking, Voice, Fax, Data & VTC)	R	R	R	C	C	NA
D-2.4		**E1 SS7 (Q.735.3)** (Trunking, Voice, Fax, Data & VTC)	R[2]	R[2]	R[2]	C	C	NA
D-2.5		**T1 CAS (MFR1, DTMF, DP)** (Trunking, Voice, Fax, Data & VTC)	R	R	R	R[3]	C	C[4]
D-2.6		**E1 CAS (MFR1, DTMF, DP)** (Trunking, Voice, Fax, Data & VTC)	R[2]	R[2]	R[2]	R[5]	C	C
D-2.7		**T1 ISDN PRI NI 1/2 (T1.619a)** (Trunking, Voice, Fax, Data & VTC)	R	R	R	R	R	C[4]
D-2.8		**E1 ISDN PRI (Q.955.3)** (Trunking, Voice, Fax, Data & VTC)	R[2]	R[2]	R[2]	C	C	C
D-3	**Features & Capabilities**							
D-3.1	**Common Features**		NA	R[6]	R[6]	R[6]	R[6]	R[6]
D-3.2	**Attendant**		NA	R	R	C	C	C
D-3.3	**Public Safety**		C	R[6]	R[6]	R[6]	C	C
D-3.4	**Preset Conferencing**		R	R	R	C	C	C
D-3.5	**Nailed-Up Connections**		R	R	R	C	C	C
D-3.6	**Precedence Access Threshold**		C	C	C	C	C	C
D-3.7	**DSN Hotline Services**		C	R	R	R	C	C
D-3.8	**Tandem Switching**		R	R	NA	NA	NA	NA
D-3.9	**Network Management**		R[6]	R[6]	R[6]	R[6]	C	C
D-3.10	**ISDN Services**		C	C	C	C	C	C
D-3.11	**Synchronization**		R	R	R[6]	R[6]	R[6]	R[6]
D-3.12	**Reliability**		R	R	R[6]	R[6]	R[6]	C
D-3.13	**Security**		R[7]	R[7]	R[7]	R[7]	R[7]	C
D-4	**RSU**							
D-4.1	**Normal Operating Condition**		NA	NA	C[8]	C[8]	C[8]	C[8]
D-4.2	**Degraded Operating Conditions**		NA	NA	C[8]	C[8]	C[8]	C[8]
D-5	**VoIP**							
D-5.1	**VoIP Systems**		C[9]	C[9]	C[9]	C[9]	C[9]	C[9]
D-5.2	**LANs**		C[9]	C[9]	C[9]	C[9]	C[9]	C[9]

Table 1. DSN Switching System Requirements by Switch Type (continued)

GSTP Ref.	Requirement	Switch Type					
		TS	MFS	EOS	SMEO	PBX1	PBX2
D-6	Network Gateways						
D-6.1	PSTN	C	R	R	R	C	C
D-6.2	Tactical	C	R	R	C	NA	NA
D-6.3	DRSN	C	R	R	C	NA	NA
D-6.4	EMSS	C[10]	C[10]	C[10]	C[10]	C[10]	C[10]
D-6.5	NGCS	C[10]	C[10]	C[10]	C[10]	C[10]	C[10]

Notes:
1. For PBX 2, either 2W analog or ISDN BRI NI 1/2 (non-MLPP) may be provided
2. E1 certification is only required for those switching systems that will be deployed in Europe.
3. For SMEO, T1 CAS DTMF and DP is required. T1 CAS MFR1 is conditional.
4. For PBX2, either T1 CAS (non-MLPP) or T1 ISDN PRI NI 1/2 (non-MLPP) may be provided.
5. For SMEO, E1 CAS MFR1, DTMF, and DP is required only for those switching systems that will be deployed in Europe.
6. Not all requirements of the section apply. See detailed requirements list in appendix C for specific list of requirements that apply.
7. GSCR security requirements are verified through LoC and DISA's IATP.
8. RSU service need not be provided and is conditional. RSUs may be certified as an End Office (EOS or SMEO) or PBX (PBX1 or PBX2). To be certified, an RSU must meet all appropriate switch type (i.e., EOS, SMEO, PBX1, or PBX2) requirements when connected to its host. If provided, RSUs will be tested IAW D-5 RSU test procedures.
9. VoIP service need not be provided and is therefore conditional. If provided, VoIP systems will be tested IAW D-6 test procedures.
10. CJCS approved requirements not yet defined. Test procedures to be developed.

Legend:

2W – 2 Wire
BRI – Basic Rate Interface
C – Conditional
CAS – Channel Associated Signaling
CJCS – Chairman Joint Chiefs of Staff
DISA – Defense Information Systems Agency
DP – Dial Pulse
DRSN – Defense Red Switch Network
DSN – Defense Switched Network
DTMF – Dual Tone Multi-Frequency
E1 – European Transmission Std. (2.048 Mbps)
EMSS – Enhanced Mobile Satellite System
EOS – End Office Switch
Fax – Facsimile
GSCR – Generic Switching Center Requirements
GSTP – Generic Switch Test Plan
IATP – Information Assurance Test Plan
IAW – In accordance with
ISDN – Integrated Services Digital Network
ITU – International Telecommunications Union
LAN – Local Area Network
LoC – Letter(s) of Compliance
Mbps – Megabits per second
MLPP – Multi-level Precedence and Preemption
MFR1 – Multi-Frequency Recommendation 1
MFS – Multifunction Switch
NA – Not Applicable
NATO – North Atlantic Treaty Organization
NGCS – NATO Gateway Communications System
NI 1/2 – National ISDN Std. 1/2
PBX – Private Branch Exchange
PBX1 – Private Branch Exchange Type 1
PBX2 – Private Branch Exchange Type 2
PRI – Primary Rate Interface
PSTN – Public Switched Telephone System
Q.735.3 – ITU SS7 Signaling Std. For E1 MLPP
Q.955.3 – ITU ISDN Signaling Std. For E1 MLPP
R – Required
Ref – Reference
RSU – Remote Switching Unit
SMEO – Small End Office
SS7 – Signaling System 7
Std – Standard
T1 – American Transmission Std. (1.544 Mbps)
T1.619a – SS7 and ISDN Signaling Std. For T1
TS – Tandem Switch
VoIP – Voice over Internet Protocol
VTC – Video Teleconferencing

SCOPE

The DSN is a worldwide and complex telecommunications network comprised of thousands of telecommunication switches. It is not possible to accurately emulate the DSN in its entirety and conduct DSN network level interoperability testing per se. Rather, telecommunications switches that are components of the DSN are tested and certified to provide specific DSN services and interoperate with each other. Interoperability testing of individual DSN telecommunication switches will be carried out at JITC, Fort Huachuca, AZ unless otherwise specified. Testing of DSN telecommunication switches will be in an emulated network that resembles the DSN operational architecture. Depictions of the test environments are provided in the detailed test procedures contained in appendix E.

OBJECTIVES AND METHODOLOGY

The major test objectives of the GSTP are to verify through interoperability certification testing and/or LoC that switches meet the requirements for:

a. GSCR interface/signaling requirements for trunks and lines.

b. DSN services (voice, facsimile, data, and VTC) requirements per interface and signaling types.

c. GSCR features and capabilities.

d. Interoperability with DSN network gateway interfaces.

The test methodology for this GSTP is to conduct interoperability testing using JITC test resources. The switch will be placed in a network that emulates the DSN. End-to-end testing between the switch and other lab resources shall be conducted. In addition to end-to-end testing, demonstration or inspection of the system to verify requirements shall be carried out. An analysis of the vendor's LoC shall be conducted to verify that those "L" requirements have been met. Table 2 outlines the test methodology for each requirement.

Table 2. Requirements Test Methodology

Requirement		Test Methodology
DSN Interfaces		
Line	**2 Wire Analog** (Access, Voice, Fax, Data & VTC)	In conjunction with LOCs, line requirements will be verified by making manual calls. Over the duration of the test, several thousand calls will be made from each line type across each of the trunk types to ensure correct interactions. TDME will be used to verify that line identification, signaling, alerting signals and tones, WWNDP, call processing, and call treatments meet DSN requirements. Calls of all precedence levels will be conducted to verify proper MLPP interaction. Fax, data, and VTC calls will be sent from the line side to verify that DSN services can be passed.
	ISDN BRI NI 1/2 (T1.619a) (Access, Voice, Fax, Data & VTC)	
Trunk	**T1 SS7 (T1.619a)** (Trunking, Voice, Fax, Data & VTC)	In conjunction with LOCs, requirements for trunk interfaces will be verified as follows: Using TDME basic trunking requirements such as framing, line coding, alarms, and timing will be verified. TDME will also be used to monitor trunks to ensure that the WWNDP is being adhered to and that the correct digit outpulsing formats is occurring. Through the use of call loading devices, several thousand calls will be placed across each trunk type. The call loading will be conducted using all five precedence levels to ensure MLPP interaction. While being loaded, voice quality measurements will be conducted. Fax call loading of several hundred calls will be conducted to ensure that minimum fax rates are being met. Faxes sent will be the IEEE Std. 167A-1995 fax test sheet so that fax quality can be measured. Data calls using modems and end equipment capable of 56 Kbps/64 Kbps will be used to verify that each trunk type can support data transfers. VTCs will be set up using lab VTC equipment to verify that trunk types can support VTC transfer rates. VTC quality will be a test conductor subjective measurement.
	E1 SS7 (Q.735.3) (Trunking, Voice, Fax, Data & VTC)	
	T1 CAS (MFR1, DTMF, DP) (Trunking, Voice, Fax, Data & VTC)	
	E1 CAS (MFR1, DTMF, DP) (Trunking, Voice, Fax, Data & VTC)	
	T1 ISDN PRI NI 1/2 (T1.619a) (Trunking, Voice, Fax, Data & VTC)	
	E1 ISDN PRI (Q.955.3) (Trunking, Voice, Fax, Data & VTC)	

Table 2. Requirements Test Methodology (continued)

Requirement	Test Methodology
Features & Capabilities	
Common Features	In conjunction with LOCs, common features such as selective call rejection, denied originating service, and code restriction will be verified through demonstration of the function. The SUT will be configured to enable the functionality IAW the GSCR requirement and the test conductor shall observe that the functionality is provided.
Attendant	In conjunction with LOCs, if provided, the SUT's attendant console functionality will be verified through demonstration of GSCR requirements. Attendant features to be observed by the test conductor include the ability to initiate all levels of precedence calls, visual display of call information, override capability, call deflection, auto recall, and call queuing.
Public Safety	In conjunction with LOCs, public safety requirements such as 911 service and call tracing will be verified by the test conductor through the SUT's demonstration of these features.
Preset Conferencing	Preset conferencing features will be verified through demonstration of the functionality. Verification that the SUT can support up to 10 bridges each with 20 conferees will be conducted through manual set up of the 10 bridges. The Test Conductor shall observe that the bridge functionality is provided IAW GSCR requirements.
Nailed-Up Connections	The Test Conductor shall verify the nailed-up connection feature through observation of the feature being demonstrated. The feature shall be tested between like trunks (i.e., T1/T1 and unlike T1/E1) to ensure correct PCM interaction. The feature will also be demonstrated between CAS and CCS trunks to verify interoperability. An LoC shall be accepted to verify that the switch can support nail-ups on 10% of its circuits.
Precedence Access Threshold (PAT)	The PAT feature shall be verified through demonstration of the feature. The SUTs ability to support 7 PAT mechanisms and that PAT screening is provided by the SUT is demonstrated.
DSN Hotline Services	Hotline services shall be verified through observation of the feature. The Test Conductor shall observe that the SUT can provide hotline restrictions, auto initiation, and hotline protection. Ten hotline calls will be conducted to verify that hotline services are interoperable with the WWNDP.
Tandem Switching	For TSs and MFSs, demonstration that the SUT can provide tandem switching functionality shall be observed by the Test Conductor.
Network Management (NM)	In conjunction with LOCs, the Test Conductor will verify NM features by observing the feature being demonstrated. NM measurements will be verified by making test calls and getting traffic counts from the SUT through NM reports generated by the SUT. NM Controls will be enabled on the SUT and test scenarios run to demonstrate that NM controls function IAW the GSCR.
ISDN Services	In conjunction with LOCs, most ISDN service features shall be verified through LoC. EKTS will be verified through demonstration because of its potential to impact MLPP. EKTS features shall be enabled by the Test Conductor to ensure GSCR requirements are met.
Synchronization	The SUT's ability to meet synchronization (timing) both internal and external will be verified by running BER tests and using TDME to measure timing slips. Timing requirements are also verified by the running of the various voice, fax, data, and VTC scenarios.
Reliability	The reliability of the SUT is verified primarily through LoC. Tests that simulate hardware/software failures will be conducted to ensure that calls are not lost upon failover transitions. The Test Conductor shall observe that links failover in less than 1 second and that calls remain active throughout the failover.
Security	Security for the SUT is verified via LoC. Additional testing by a DISA IA team is conducted IAW the IATP. The team normally conducts testing at the JITC Fort Huachuca facility.

Table 2. Requirements Test Methodology (continued)

RSU	
Normal Operating Condition	Normal RSU functionality is verified by running GSTP procedures while the RSU is connected to its host switch. The same procedures that are run against the host are run against the RSU to verify that the same functionality provided end users at the host are provided to RSU end users.
Degraded Operating Conditions (Stand-alone and Partial Stand-alone)	The Test Conductor verifies degraded operating functionality by manually taking the host-RSU umbilical connection out of service for stand-alone condition . While the umbilical is disconnected, intra-RSU calls are made to ensure that intra-RSU MLPP functions. Test calls across any links such as to the commercial phone system are also made. While disconnected, the Test Conductor shall observe that AMA reports need not be provided. The vendor shall provide an LoC to verify that 3% of users can be provided assured dial tone. For partial stand-alone mode, the umbilical will be saturated with traffic then test procedures conducted to verify requirements met.
VoIP	
VoIP Systems	VoIP system functionality is verified through the use of both TDME and observation. TDME is used to verify that voice quality, latency and packet loss are measured. A LoC is required to verify that VoIP systems are IPv6 capable.
LANs	IP loaders and TDME is used to measure LAN parameters such as CoS and QoS. Demonstration that the LAN supports queuing and policing mechanisms is verified through observation by the Test Conductor. If necessary, LAN loading via a JITC-TIC fiber connection can be conducted. Using TIC remote terminal emulators, IP traffic can be generated and passed over the IP LAN at the JITC. While loaded, voice quality, latency, and packet loss is measured by TDME.
Network Gateways	
PSTN	Interoperability between the DSN and network gateways is verified by making test calls (voice, fax, data, and VTC) where possible. At the JITC, links between the DSN and simulated other gateways are set up. Emulated DRSN, tactical, and PSTN networks are configured at the JITC Fort Huachuca facility and test calls made between each gateway. TDME measures protocol and call processing information to verify interoperability. Commercial interfaces are set up between switches to simulate the PSTN; connectivity to tactical switches through a simulated STEP and connectivity to a DRSN switch are also set up. EMSS and NGCS requirements are currently not defined and not tested.
Tactical	
DRSN	
EMSS	
NGCS	

Legend:

AMA – Automated Message Accounting
BER – Bit Error Rate
BRI – Basic Rate Interface
CAS – Channel Associated Signaling
CCS – Common Channel Signaling
CoS – Class of Service
DISA – Defense Information Systems Agency
DP – Dial Pulse
DRSN – Defense Red Switch Network
DSN – Defense Switched Network
DTMF – Dual Tone Multi-Frequency
E1 – European Transmission Std. (2.048 Mbps)
E911 – Emergency 911 Service
EKTS – Electronic Key telephone Service
EMSS – Enhanced Mobile Satellite system
Fax – Facsimile
GSCR – Generic Switching Center Requirements
GSTP – Generic Switch Test Plan
IA – Information Assurance
IATP – Information Assurance Test Plan
IAW – In accordance with
IEEE – Institute of Electrical and Electronics Engineers
IP – Internet Protocol
IPv6 – Internet Protocol Version 6
ISDN – Integrated Services Digital Network
ITU – International Telecommunication Union
JITC – Joint Interoperability Test Command
Kbps – Kilobits per second
LAN – Local Area Network
LoC – Letter(s) of Compliance
Mbps – Megabits per second
MFR1 – Multi-Frequency Recommendation 1
MLPP – Multi-Level Precedence & Preemption
MFS – Multifunction Switch
NATO – North Atlantic Treaty Organization
NGCS – NATO Gateway Communications System
NI 1/2 – National ISDN Std. 1/2
NM – Network Management
PAT – Precedence Access Threshold
PCM – Pulse Code Modulation
PRI – Primary Rate Interface
PSTN – Public Switched Telephone System
Q.735.3 – ITU SS7 Signaling Std. For E1 MLPP
Q.955.3 – ITU ISDN Signaling Std. For E1 MLPP
QoS – Quality of Service
RSU – Remote Switching Unit
SS7 – Signaling System 7
Std – Standard
STEP – Standardized Tactical Entry Point
SUT – System Under Test
T1 – American Transmission Std. (1.544 Mbps)
T1.619a – SS7 and ISDN Signaling Std. For T1
TDME – Test, Measuring and Diagnostic Equipment
TIC – Technology Integration Center
TS – Tandem Switch
VoIP – Voice over Internet Protocol
VTC – Video Teleconferencing
WWNDP – Worldwide Numbering & Dialing Plan

Specific test objectives, criteria, and data required are listed in appendix D. The test methodology is organized around certification of the SUT's interfaces, feature capabilities, and network gateways. Configuration diagrams and detailed test procedures for the SUT, TS through PBX1, are provided in appendix E. The test resources requirements are listed in appendix F.

PRESENTATION OF RESULTS AND ANALYSIS PROCEDURES

Testers will determine the extent of the system interoperability based on the ability of the system to meet criteria provided in appendix D. Testers shall collect data as pass/fail events as well as collect empirical data where required. Any limitations and/or anomalies found during testing shall be recorded in a test conductor log. Requirements not met shall be recorded as test discrepancy reports (TDRs). An example of a TDR is given in figure 4. Empirical data collected shall be recorded in tabular format where possible. Data collection forms are provided as part of the detailed test procedures. An example of a test procedure with its associated data collection is provided in table 3.

Test Discrepancy Report			
Discrepancy No.	**Vendor:**		**Date Opened:**
Title:			
Ref:			
Software Version:		**System Name:**	
Test Configuration			
Switch/Peripheral Equipment			**Call Type**
Origination Node switch Type:	Peripheral Device:		
Tandem Node:	Trunk In:		**Precedence**
	Trunk Out:		
Destination Node Switch Type:	Peripheral Device:		
Problem Description			
Problem Solution			
Director's Signature:			**Date Closed:**

Figure 4. Example TDR

Table 3. Test Procedure and Data Collection Form Example

<table>
<tr><th>Ref #</th><th>Configuration and/or Diagram</th><th>Test Procedure(s)</th><th>Expected Result(s)</th></tr>
<tr><td rowspan="2">A</td><td>PCM-24/PCM-30
Requirement: TS, MFS, & EOS | Reference: GSCR Sect. 7.3
Configure SUT as a tandem node with incoming (T1 SS7) link and outgoing (E1 SS7, E1 PRI and E1 CAS) links between origination node and destination node.</td><td>1. Place a call from ON subscriber to DN subscriber and verify mu-law to a-law conversion.</td><td>Mu-law to a-law conversion via T1 SS7link to:
<table>
<tr><th></th><th>E1 SS7</th><th>E1 PRI</th><th>E1 CAS</th></tr>
<tr><td>Analog</td><td></td><td></td><td></td></tr>
<tr><td>BRI</td><td></td><td></td><td></td></tr>
<tr><td>Digital</td><td></td><td></td><td></td></tr>
<tr><td>VoIP</td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Notes:</td><td></td></tr>
<tr><td rowspan="2">B</td><td>DID
Requirement: MFS & EOS | Reference: GSCR 2.3.2
Configure the SUT to have a PBX1 connected to it with DID trunks. Configure 2 subscribers, P1 and P2 on the PBX. P2 has a restriction not to receive terminating calls. Configure ON with 3 subscribers ON1, ON2, & ON 3.</td><td>1. Place ROUTINE call from ON1 to P1.
2. Place ROUTINE call from ON2 to P2.
3. Place PRIORITY call from ON3 to P1.</td><td>1. Call completes. Y/N
2. Reroute to announcement, reorder tone or attendant. Y/N
3. ON1 and P1 receive PNT. Y/N
ON3-P1call completes. Y/N</td></tr>
<tr><td>Notes:</td><td></td></tr>
</table>

Legend:

BRI	– Basic Rate Interface	**PCM**	**– Pulse Code Modulation**
CAS	**– Channel Associated Signaling**	**PRI**	**– Primary Rate Interface**
DID	**– Direct Inward Dialing**	**Ref**	**– Reference**
DN	**– Destination Node**	**Sect.**	**– Section**
EOS	**– End Office Switch**	**SS7**	**– Signaling System 7**
GSCR	**– Generic Switching Center Requirements**	**SUT**	**– System Under Test**
MFS	**– Multifunction Switch**	**TP**	**– Test Procedure**
ON	**– Origination Node**	**TS**	**– Tandem Switch**
PBX	**– Private Branch Exchange**	**VoIP**	**– Voice over Internet Protocol**